REMARKS

At the outset, Applicants and Applicants' attorney express gratitude for the comprehensive and analytical Office Action dated October 15, 2002. An attempt has been made to provide a response on a similar level. In the October 15th Office Action, the Examiner argued that elected claims 4-6 do not read on the elected species of FIGs. 1C and 1F because Figures 1C and 1F do not show an electromagnetic wave source and withdrew claims 4-6 from consideration. The Examiner also objected to the drawings under 37 CFR 1.83(a) stating that the defect photonic mode is not shown in the drawings. The Examiner objected to claim 9 on the ground of a double identifier informality. The Examiner rejected claims 1 and 15 under 35 USC 112 as being allegedly indefinite. Finally, the Examiner rejected claims 1-3, 9, 15 and 16 under 35 USC 102(e) as being anticipated by Kopp et al (U.S. Patent No. 6,404,789), alleging that Kopp substantially teaches applicant's invention as claimed. The Examiner's arguments are respectfully traversed in light of the following amendments and remarks. A brief telephone interview with the Examiner was also conducted on April 14, 2003.

Objection to the Drawings

The Examiner objected to the drawings under 37 CFR 1.83(a) stating that the defect photonic mode must be shown in the drawings. Applicants have enclosed a proposed change to FIG. 5 showing the defect mode. Because this response is being submitted by facsimile, marking the change in red ink is impossible. Applicants have identified the proposed change with a text remark on the drawing. The change shows the defect photonic mode as a spike in the center of the top graph diagram of FIG. 5 (i.e. at the position of centrally between frequencies of 4.8×10^{14} Hz and 4.9×10^{14} Hz on the X-axis). If this change is acceptable it will be reflected in the formal

drawings. Applicants have also amended the specification to state that the defect mode is shown in FIG. 5. No new matter has been introduced with this amendment.

Objection to Claim 9

Examiner has objected to Claim 9 in view of a typographical informality. number of spelling errors. Applicants have amended claim 9 to correct the error pointed out by the Examiner. Applicant believed that this amendment obviate the Examiner's objection.

The 35 U.S.C. 112 Rejection of Claims 1 and 15

The Examiner has rejected claims 1 and 15 under 35 U.S.C. 112 second paragraph as being allegedly indefinite and for allegedly failing to point out and distinctly claim the inventive subject matter. The Applicants appreciate the Examiner's detailed step-by-step analysis of claims 1 and 15 and have amended claims 1 and 15 to address the issues brought up by the Examiner and to more clearly point out and claim the subject matter of the invention.

With respect to definition of a "periodic structure", Applicants respectfully point out that in the dielectric lasing art, a periodic structure is a commonly used term that typically refers to a structure comprising alternating layers of dielectric material. Based on Applicants' earlier patented inventions, the term periodic structure is now also used in the lasing art to encompass homogeneous and/or layered chiral structures (this is discussed in the Applicants' specification from page 12 line 1 to page 14, line 4, the term "periodic structure" is further summarily defined in Applicants' specification, page 6, lines 4-14).

Essentially, a periodic structure is any dielectric or chiral structure having periodic refractive index modulation of a particular amplitude along its length. This periodic refractive index

modulation results in the structure having a photonic transmission band gap (i.e. a "stop band") with multiple long-lived photonic modes positioned at the edges of the stop band (and a defect mode at the center of the band if the periodic stricture contains a defect). Applicants' earlier invention discussed in the commonly assigned U.S. Patent No. 6,404,789 of Kopp et al. (that the Examiner later sited as his basis for the 35 USC 102 (e) rejection in this case and that Applicants have incorporated by reference in the specification of the present invention), taught that optimal lasing occurs corresponding to one of the stop band edge photonic modes (or the defect mode if it is present) when optical gain is introduced into the periodic structure (for example by electronically or optically pumping excitable material in the periodic structure) such that peak gain emission corresponds to the photonic band edge mode used for lasing and exceeds the lasing threshold of that mode. This is described in greater detail in the '789 Kopp patent at Column 5, line 55 to Column 6, line 14.

However, experimentation with structures disclosed in the '789 patent, showed that when peak gain continues to exceed the lasing threshold, the lasing emission loses coherency, suffering from filamentation, even before the lasing threshold of another photonic mode is reached – an undesirable effect.

The essence of Applicants' invention is an inventive apparatus utilizing a novel periodic structure that solves the above-described challenge by enabling and maintaining stable coherency in single mode wide area lasing even when the gain produced in the structure by the excitation means (optical or electronic) exceeds the lasing threshold of the photonic mode at which lasing occurs. This crucial property of the inventive apparatus is outlined in Applicants' specification, page 17, lines 11-16.

The inventive apparatus accomplishes this objective by utilizing the novel periodic

structure having a periodic refractive index modulation configured with an amplitude that is selected such that the frequency of the photonic mode utilized for lasing is higher than the frequency of the nearest other photonic mode by a certain predefined amount (as discussed earlier, numerous photonic modes exist at each edge of the stop band but only a single mode is utilized for lasing – the multiple band edge photonic modes are shown in the bottom graph of Applicants' FIG. 5).

Advantageously, Applicants have also discovered that this minimum required separation between modes is a function of the thickness of the structure (T) and the average refractive index of the structure (N). Thus, to practice the present invention, given the requirements of desirable structure thickness (T) and average refractive index (N) of the material to be used, one skilled in the art would configure the inventive structure by selecting a value for the amplitude of the periodic refractive index modulation in the structure such, that the separation between the photonic mode used for lasing and the nearest lower frequency photonic mode is greater than c/2TN. Configuring the inventive structure with this amplitude value (or other amplitude values that provide a greater separation between the lasing photonic mode and the nearest lower frequency photonic mode) will result in a desirable apparatus that is capable of maintaining coherency of wide area lasing even when the gain in the structure exceeds the lasing threshold.

Applicants have extensively amended claims 1 and 15 to more clearly define the inventive subject matter and to indicate structural features necessary to achieve the desired result. In addition, claims 1 and 15 now better define the periodic structure, explain that the "nearest lower frequency photonic mode" is selected from a plurality of photonic modes of different frequencies that are produced by the periodic structure, and further provide antecedent basis for the term "magnitude" with respect to optical gain produced in the structure.

In light of the amendments to claims 1 and 15 and the above remarks, Applicants respectfully request the rejection of claims 1 and 15 under 35 U.S.C. 112 be withdrawn.

The 35 U.S.C. 102(e) Rejection of Claims 1-3, 9, 15, and 16 in view of Kopp et al. U.S. Patent No. 6,404,789 (hereinafter "Kopp").

The Examiner rejected claims 1-3, 9, 15 and 16 under 35 U.S.C. 102(e) as being allegedly anticipated by Kopp (U.S. Patent No. 6,404,789). The Examiner's rejection is respectfully traversed in light of the newly amended claims 1 and 15 as well as the following remarks.

As discussed above in connection with response to the 35 U.S.C. 112 rejection, while Applicants' inventive apparatus and method appear similar to that of Kopp, in fact Applicants' invention discloses a patentably distinct improvement over the teachings of Kopp. Kopp teaches that any periodic structure capable of producing a photonic stop band that contains excitable light-emitting material will produce lasing when the light-emitting material is excited to produce optical gain in the structure of sufficient magnitude to meet the lasing threshold of one of the photonic modes at one of the stop band edges. However, Kopp does not address the problem that occurs when the gain magnitude is increased above the lasing threshold – i.e. eventual loss of laser beam coherency and undesirable filamentation. Kopp does not suggest, teach or disclose any special configuration of the refractive index modulation of the periodic structure used in the Kopp laser based on the thickness and average refractive index of the structure. In stark contrast, the essential inventive step in Applicant's invention, that is not present in, or suggested by Kopp, is configuration of the periodic refractive index modulation amplitude of the periodic structure depending on the characteristics of the periodic structure (i.e., values of T & N) as defined by the

equation shown in claims 1 and 15. This configuration of the modulation amplitude ensures a proper separation between the photonic mode at which lasing occurs, and the nearest other lower frequency photonic mode, thus ensuring that the laser beam maintains its coherency during single mode lasing even if the gain magnitude significantly exceeds the lasing threshold.

Because Kopp does not teach applicant's invention as claimed, Applicants believe that claims 1, and 15 are in condition for allowance. Because claims 2, 3, 9, and claim 16 are in proper dependent form and depend from allowable independent claims 1, and 15, respectively, claims 2, 3, 9, and claim 16 are also allowable. Accordingly, Applicants respectfully request that the Examiner's rejection of claims 1-3, 9, 15, and 16 under 35 U.S.C. 102(e) be withdrawn.

(continued on next page)

Conclusion and Request for Consideration of Claims to Additional Species

In the Election/Restriction requirement dated August 12, 2002 (Paper No. 3), the Examiner indicated that claim 1 is generic. Claims 4, 5, 7, 8 and 21 are properly dependent claims from generic claim 1 and include all limitations of that claim. Applicants have further amended claims 4, 7, 8, and 21 to correspond to the amendments in the currently amended claim 1. In accordance with the above amendments and remarks, it is respectfully requested that the various objections and rejections be withdrawn.

Applicants thus respectfully request allowance of claims 1-3, 9, 15 and 16 and consideration and allowance of previously withdrawn dependent claims 4, 7, 8, and 21 in their current form as additional species claims properly dependent on allowable generic claim 1, and ask that the Examiner pass the application to issue. If there are any questions, the Examiner is urged to contact applicants' attorney at the below-noted telephone number.

Respectfully submitted,

By _____

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Dated: April 15, 2003